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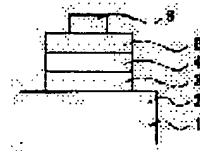
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## (54) ORGANIC ELECTROLUMINESCENT ELEMENT AND MATERIAL FOR ORGANIC ELECTROLUMINESCENT ELEMENT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an organic EL element material having heat stability, a high purity as a blue light and a high efficiency.

SOLUTION: This element is composed of a glass substrate 1, a transparent anode 2, TPD 3 as a hole injection and transport layer, an organic luminescent layer 4, Alq3 5 as an electron injection and transport layer and a cathode 6. The organic luminescent layer is made of  $\mu$ -oxy-di[bis(2-(2-benzoxazolyl)-phenolato) aluminum (III)] being an aluminum complex. A direct current voltage is applied between the anode 2 and the cathode 6 so that the anode 2 may be positive in potential, and the cathode 6 may be negative in potential. The organic luminescent layer emits a blue EL emission having an intensity of 1314cd/m<sup>2</sup> at the maximum when the applied voltage is 16V. It has an emission spectrum having a peak wavelength of 420nm and chromaticity coordinates: x=0.185 and y=0.178, so that it has a high purity as a blue light. The organic EL element material is stable against heat and resistant to deterioration. Since the element structure is a three-layer structure in which the organic luminescent layer is sandwiched between the electron injection and transport layer and the hole injection and transport layer, the diffusion of excitons into the electrodes can be inhibited. Therefore, the efficiency can be improved and the ineffective current can be reduced with a consequent improved lifetime.



## LEGAL STATUS

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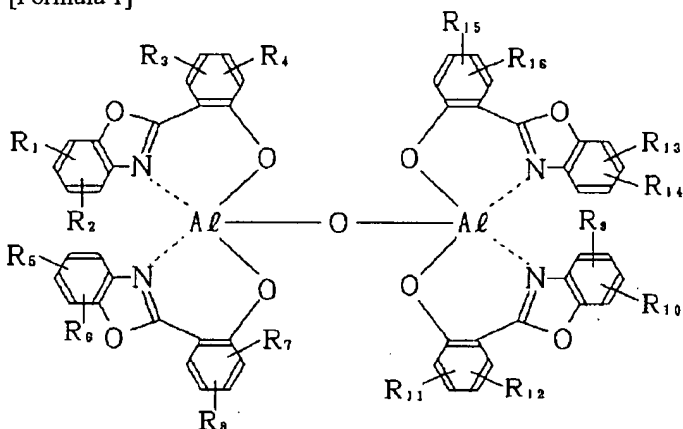
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[Claim(s)]

[Claim 2] Organic electroluminescent element according to claim 1 whose aforementioned aluminum complexes are mu-OKISOJI [screw (2-(2-benzoxazolyl)-phenolate) aluminum (III)] and/or its derivative.

[Claim 4] Organic electroluminescent-element material expressed with the following-ization 1.

[Formula 1]



[Claim 5] Organic electroluminescent-element material according to claim 4 which forms the heterocycle which is not replaced [ the heterocycle formula aromatic ring which is not replaced / the ring formula aromatic ring which is not replaced / the aliphatic series type ring which is not replaced / substitution or /, substitution, or /, substitution, or /, substitution, or /, substitution, or ] by the adjoining aforementioned substituents.

[Translation done.]

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**DESCRIPTION OF DRAWINGS**

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[Brief Description of the Drawings]

[Drawing 1] Drawing 1 is drawing showing the structure of the organic EL element in the example 1 of this invention.

[Drawing 2] Drawing 2 is drawing showing the fluorescence spectrum in the solution of an organic EL-element material in the example 1 of this invention.

[Drawing 3] It is drawing showing the fluorescence spectrum of the thin film of an organic EL-element material in the example 1 of this invention of drawing 3 .

[Drawing 4] Drawing 4 is drawing showing the spectrum of the organic EL element in the example 1 of this invention.

[Drawing 5] Drawing 5 is drawing showing the basic composition of the structure which combined the electron hole transporting bed and the organic luminous layer organic [ EL ].

[Description of Notations]

- 1 Substrate
- 2 Anode as an Electrode
- 3 TPD as a Hole-Injection Transporting Bed
- 4 Organic Luminous Layer
- 5 Alq3 as an Electron-Injection Transporting Bed
- 6 Cathode as an Electrode

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[Translation done.]

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to an organic electroluminescent-element material (it is hereafter called an organic EL-element material) suitable for the organic luminous layer of organic electroluminescent element (it is hereafter called an organic EL element) and organic electroluminescent element.

[0002]

[Description of the Prior Art] An organic EL element is a light emitting device of the laminated structure which sandwiched the thin film as an organic luminous layer containing a fluorescence nature organic compound by cathode and the anode plate, and produces the electroluminescence which was in agreement with the fluorescence spectrum by making an electron and an electron hole pour in and recombine with the aforementioned organic luminous layer.

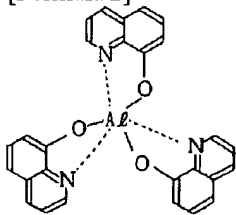
[0003] The thing of structure which established the structure which combined \*\* electron hole transporting bed and the organic luminous layer, the structure which combined \*\* electronic transporting bed and the organic luminous layer, and three structures of structure \*\* which sandwiched the organic luminous layer by \*\* electron hole transporting bed and the electronic transporting bed between anode cathodes as structure of the aforementioned organic EL element, respectively is known.

[0004] Drawing 5 shows the basic composition of the structure of the aforementioned \*\* which combined the electron hole transporting bed and the organic luminous layer organic [ EL ]. On the substrate 100 of a translucency, the laminating of the anode 101 of translucencies, such as ITO (Indium Tin Oxide), the electron hole transporting bed 102, the organic luminous layer 103, and the cathodes 104, such as an Mg:Ag alloy, is carried out one by one. The thickness of each class of the electron hole transporting bed 102 which is an organic thin film here, and the organic luminous layer 103 is about 50nm, respectively. If the direct current of minus and plus in an anode 101 is impressed to a cathode 104, the organic luminous layer 103 will emit light. This luminescence is taken out from the ITO side through a substrate 100. Vacuum deposition is performing membrane formation of each class.

[0005] Alq3 to which the aforementioned organic luminous layer 103 is expressed with \*\* 2 here it is . Alq3 It is 8-hydro oxyquinoline aluminum which is the chelate complex in which 8-hydro oxyquinoline carried out the chelate bond to main aluminum. this Alq3 from -- the becoming aforementioned organic luminous layer 103 showed green luminescence of 550nm of peak wavelengths

[0006]

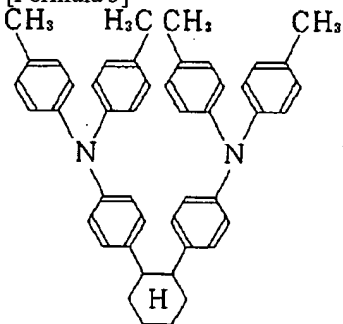
[Formula 2]



[0007] diamine (Diamine) to which the aforementioned electron hole transporting bed 102 is expressed with \*\* 3 here it is .

[0008]

[Formula 3]

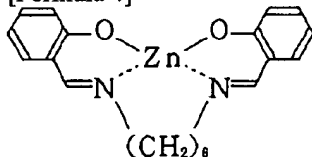


[0009] Above Alq3 Although it can say that it is the material which was excellent in luminescence brightness, the field of thermal stability, etc. as an organic EL-element material used for the aforementioned organic luminous layer 103, the luminescent color is green as above-mentioned. An organic EL-element material (fluorescent substance) which emits light in multicolor-izing, or the blue which was equipped with still more sufficient luminescence brightness and practical color purity in addition to an organic EL-element material of green luminescence in order to have made it full color and red is needed in an organic EL element.

[0010] It is the benzo oxazole zinc complex (OXZ) Zn 2 expressed with the azomethine zinc complex Zn (1 AZM-Hex) expressed with \*\* 4 as an organic EL-element material which shows blue luminescence, for example, and \*\* 5. It is known.

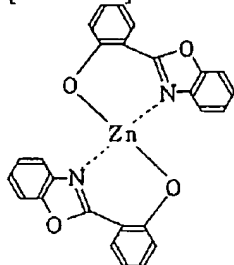
[0011]

[Formula 4]



[0012]

[Formula 5]



[0013]

[Problem(s) to be Solved by the Invention] Although there is much what shows blue fluorescence by the organic material as illustrated above, there is little what can be used as a charge of organic EL material. It is because the requirement shown below is not satisfied.

[0014] (1) It is the blue of purity which can use the fluorescence of a thin film.

(2) A thin film is thermally stable and don't condense a mothball, either. That is, the melting point changes physically, a crack produces crystallizing a low and a thin film with heat etc., and it becomes the cause by which a leakage current flows and deteriorates. Therefore, what has thermal stability high the melting point and high is desirable to the above Alq3 (418 degrees C of melting points) and equivalent bulk it has been supposed as a charge of organic EL material that are excelled conventionally.

(3) In the organic EL element of the structure of the aforementioned \*\* which combined the electron hole transporting bed and the organic luminous layer, an energy gap with an electron hole transporting bed should not become small, and don't form exciplex. If exciplex is formed, EL luminescence may become that it is not blue and green.

(4) An electron and an electron hole can be poured in and movement of a carrier is possible.

[0015] if an organic EL-element material of the conventional blue luminescence is examined from an above-mentioned viewpoint -- the above-mentioned -- although the azomethine zinc complex Zn of-izing 4 (1 AZM-Hex) has the peak wavelength of fluorescence as blue as 450nm the bottom -- the melting point -- 353 degrees C and Alq3 if compared with 418 degrees C -- low Moreover, benzo oxazole zinc complex Zn 2 of \*\* 5 (OXZ) The peaks of fluorescence are 493nm and a bluish green color, and the melting point also has problems, like it is low like the dovetail-izing 4 at 354 degrees C.

[0016] Since it is stable, high blue luminescence of purity is obtained and this invention can prevent the diffusion to the electrode of an exciton to heat, efficiency aims at offering the organic EL element which used this into an organic high EL-element material.

[0017]

[Means for Solving the Problem] The organic electroluminescent element indicated by the claim 1 has the aluminum complex which the aforementioned organic luminous layer becomes from a ligand with a 2-(2-hydroxyphenyl) benzo oxazole skeleton in the organic electroluminescent element to which the laminating of an electron-injection transporting bed, an organic luminous layer, and the hole-injection transporting bed was carried out one by one between the electrodes of a couple at least with transparent one side.

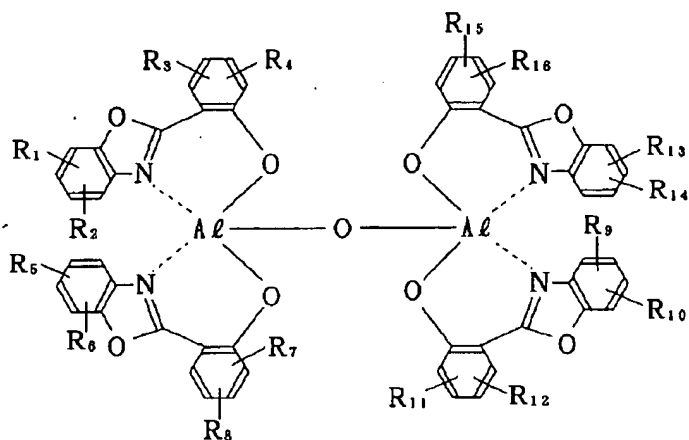
[0018] Organic electroluminescent element indicated by the claim 2 is characterized by the aforementioned aluminum complexes being mu-OKISOJI [screw (2-(2-benzoxazolyl)-phenolate) aluminum (III)] and/or its derivative in organic electroluminescent element according to claim 1.

[0019] Organic electroluminescent element indicated by the claim 3 is characterized by adding fluorescence nature matter which is different from the aforementioned aluminum complex in the organic luminous layer of organic electroluminescent element according to claim 1.

[0020] An organic electroluminescent-element material indicated by the claim 4 is expressed with the following-ization 6.

[0021]

[Formula 6]



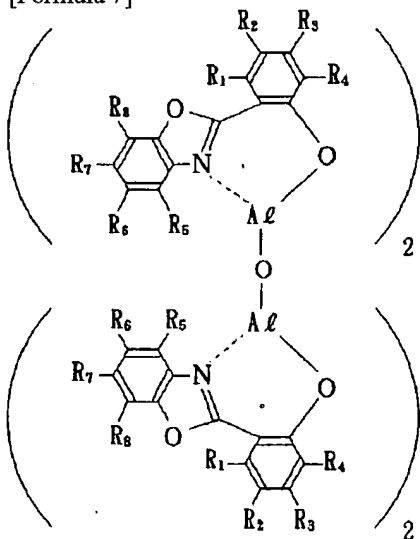
[0022] Independently R1 or R16, respectively However, a hydrogen atom, a halogen atom, An alkyl group, a cyano group, a nitro group, an ester machine, the amino group, monochrome, or the  $\text{II}$  substitution amino group, The acylamino machine, a hydroxyl group, an alkoxy group, a sulfhydryl group, an alkyloxy machine, An alkyl thio machine, an aryloxy group, an aryl thio machine, a siloxy machine, An acyl group, a cycloalkyl machine, a carbamoyl group, a carboxylic-acid machine, a sulfonic acid group, The heterocycle machine which is not replaced [ the heterocycle formula aromatic ring machine which is not replaced / the ring formula aromatic ring machine which is not replaced / the aliphatic series type ring machine which is not replaced / the aliphatic machine which is not replaced / an imido basis, substitution, or /, substitution, or /, substitution, or /, substitution, or /, substitution, or /, substitution, or ] is expressed.

[0023] In an organic electroluminescent-element material according to claim 4, the organic electroluminescent-element material indicated by the claim 5 is the adjoining aforementioned substituents, and is characterized by forming the heterocycle which is not replaced [ the heterocycle formula aromatic ring which is not replaced / the ring formula aromatic ring which is not replaced / the aliphatic series type ring which is not replaced / substitution or / substitution, or /, substitution, or /, substitution, or /, substitution, or ].

[0024] [Example] this invention person etc. came to find out having the property excellent in the aluminum complex which made the OKISA diazole the ligand, as a result of inquiring wholeheartedly about a chelate complex as an organic electroluminescent-element material of blue luminescence. In the aluminum complex equipped with the ligand in which \*\* 7 has a 2-(2-hydroxyphenyl) benzo oxazole frame, a ligand shows a general formula when they are the same by four.

[0025]

[Formula 7]



[0026] Independently R1-R8 here, respectively A hydrogen atom, a halogen atom, a cyano group, A nitro group, the amino group, a carboxy group, a sulfone machine, the acylamino machine, An ester machine, monochrome or the  $\text{II}$  substitution amino group, an alkoxy group, a sulfhydryl group, Or a methyl group, an ethyl group, a propyl group, a butyl, a sec-butyl, A tert-butyl, a BENCHIRU machine, a hexyl machine, a HEBUCHIRU machine, an octyl machine, A stearyl machine, a TORIKURORO methyl group, an aminomethyl machine, an aceto oxymethyl machine, An aceto oxy-ethyl group, an aceto oxy-propyl group, an aceto oxy-butyl, A hydroxymethyl group, a hydronalium KISHIRU ethyl group, a hydroxypropyl machine, A hydronalium KISHIRU butyl, a vinyl group, a styryl machine, an acetylene machine, an alkoxy group, A sulfhydryl group, an alkyloxy machine, an alkyl thio machine, an aryloxy group, The non-cyclic-hydrocarbon machine which is not replaced [ substituents, such as an aryl thio machine, a siloxy machine, an acyl group, a cycloalkyl machine, and a carbamoyl group, and substitution, or ], A cyclo propyl group, a cyclohexyl machine, 1, 3-cyclohexa dienyl machine, A 2-cyclopentene-1-IRU machine, 2, a 4-cyclopentadiene-1-IRIDENIRU machine, A phenyl group, a BIFE elm nil machine, a TORIFE elm nil machine, a TETORAFE elm nil machine, 2-methylphenyl machine, 3-nitrophenyl group, 4-methylthio phenyl group, 3, 5-dicyano phenyl group, o-, m-, p-tolyl group, a xylyl group, The monocycle formula hydrocarbon group which is not replaced [ the substitution of o-, m- p-KUMENIRU machine, a mesityl machine, etc., or ], A pen dripping nil machine, an indenyl group, a naphthyl group, an azulenyl machine, a HEPUTARENIRU machine, An

ASENAFUCHIRENIRU machine, a phenalenyl machine, a FUROORENIRU machine, an anthryl machine, An anthraquinonyl machine, 3-methyl anthryl machine, a phenan tolyl group, A TORIFE elm nil machine, a pyrenyl machine, a chestnut SENIRU machine, a 2-ethyl-1-chestnut SENIRU machine, A BISENIRU machine, a peri RENIRU machine, 6-chloro peri RENIRU machine, a pen terphenyl machine, A pen TASENIRU machine, a TETORAFE elm nil machine, a hexa phenyl group, a hexa SENIRU machine, A ruby SENIRU machine, a KORONENIRU machine, a TORINAFUCHIRENIRU machine, a HEPUTA phenyl group, The condensation polynuclear hydrocarbon which is not replaced [ the substitution of a pyran training nil machine, an OPARENIRU machine, etc. or ], A thienyl group, a furil machine, a pyrrolyl machine, an imidazolyl machine, a pyrazolyl machine, A pyridyl machine, a pyrazinyl machine, a pyrimidinyl group, a pilus DAJNIRU machine, the India Lil machine, A quinolyl machine, an iso quinolyl machine, a phthalazinyl machine, a KINOKISARINIRU machine, A cinchona bark ZORINIRU machine, a cull BAZORIRU machine, an acridinyl machine, a FENAJNIRU machine, A furfuryl machine, an iso thiazolyl machine, an isoxazolyl group, a furazanyl group, A phenoxazinyl machine, a benzothiazolyl machine, a benzoxazolyl machine, The aromatic heterocycle machine which is not replaced [ the heterocycle machine which is not replaced / the substitution of a benzimidazolyl machine, 2-methyl pyridyl machine, 3-cyano pyridyl machine, etc., or /, substitution or ], A hydrogen machine, a methoxy machine, an ethoxy basis, a propoxy group, a butoxy machine, a sec-butoxy machine, A tert-butoxy machine, a pentyloxy machine, a hexyloxy machine, a stearyl oxy-basis, A phenoxy machine, a methylthio machine, an ethyl thio machine, a propyl thio machine, a butyl thio machine, A sec-butyl thio machine, a tert-butyl thio machine, a bench RUCHIO machine, A hexyl thio machine, a heptyl thio machine, a heptyl thio machine, an octyl thio machine, A phenylthio machine, the amino group, a methylamino machine, a dimethylamino machine, an ethylamino machine, A diethylamino machine, a dipropylamino machine, a dibutylamino machine, a diphenylamino machine, The screw (aceto oxymethyl) amino group, screw (aceto oxy-ethyl) amino acid, Screw (aceto oxy-propyl) amino acid, screw (aceto oxy-butyl) amino acid, A dibenzylamino machine, a methyl sulfamoyl group, a dimethyl sulfamoyl group, An ethyl sulfamoyl group, a diethyl sulfamoyl group, a propyl sulfamoyl group, A butyl sulfamoyl group, a phenyl sulfamoyl group, a diphenyl sulfamoyl group, A methyl carbamoyl group, a dimethyl carbamoyl group, an ethyl carbamoyl group, A diethylcarbamoyl machine, a propyl carbamoyl group, a butyl carbamoyl group, A phenylcarbamoyl machine, a methyl carbonylamino machine, an ethyl carbonylamino machine, A propyl carbonylamino machine, a butyl carbonylamino machine, a phenyl carbonylamino machine, A methoxycarbonylamino machine, an ethoxycarbonylamino machine, a propoxy carbonylamino machine, Although it is a butoxycarbonylamino machine, a phenoxy carbonyl group, a 2-(2-ethoxy ethoxy) ethoxy basis, 2-(2-ethoxy ethoxy) ethyl thio machine, a 2-[2-(2-methoxyethoxy) ethoxy] ethyl thio machine, etc It is not limited only to these substituents.

[0027] Table 1 shows the concrete example of the matter shown in \*\* 7 as examples 1-10, and explains the synthetic method of the matter o each example etc. below.

[0028]

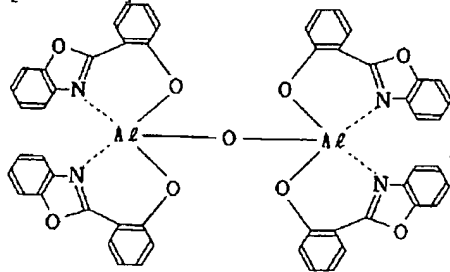
[Table 1]

実施例 No.	R1~R4	R5~R8
1	H	H
2	H	R5=CH <sub>3</sub>
3	H	R6=OCH <sub>3</sub>
4	H	R7=Ph
5	H	R7=CN
6	H	R7=OPh
7	H	R6=シクロヘキシル
8	H	R7=F
9	H	R7=NH <sub>2</sub>
10	H	R7=チエニル基

[0029] (1) aluminum 2O(OXZ) 4 which is an organic electroluminescent-element material of example 1 example 1 A structure expression is shown in \*\* 8.

[0030]

[Formula 8]



[0031] 1) Put toluene 200ml into the beaker of 500ml of synthetic methods, further, add 2-(2-hydroxyphenyl) benzo oxazole 4.22g (0.02 mols) and aluminum-G normal butoxy-monoethyl acetate 3.2g (0.01 mols), and carry out the stirring dissolution at a room temperature. This solution is left one whole day and night. Next, vacuum distillation is carried out and toluene is removed. The solid content which remained is washed with toluene. It dried in the vacuum after that. The yield of this rough product was 50%. Furthermore, after melting with chloroform, an impurity is removed by the recrystallization and sublimation refining which are performed by removing chloroform, and it uses as an organic EL material.

[0032] 2) Mass analysis, elemental analysis, FT-IR, NMR, and thermal analysis determined the structure of the identification product of a

product.

\*\* Mass analysis : m/e 910 (M+)

\*\* Elemental analysis : C<sub>32</sub>H<sub>32</sub>N<sub>4</sub>O<sub>9</sub> aluminum<sub>2</sub> C H N Calculated value / % 68.57 3.51 6.15 Measured value / % 68.47 3.40 6.05

[0033] \*\* thermal-analysis profit \*\*\*\* powder was measured by heat weight-differential thermal analysis (TG-DTA) The temperature requirement was taken as from a room temperature to 500 degrees C. Consequently, the endothermic peak was observed by 176.2 degrees C and 423.0 degrees C. 176.2 degrees C is the melting point of an impurity, and 423.0 degrees C is aluminum 2O(OXZ) 4. It is the melting point. Zn<sub>2</sub> (OXZ) Compared with 354 degrees C of melting points, and 353 degrees C of melting points of Zn (1 AZM-Hex), it got down and it turns out [ which the melting point is high sharply ] that whose matter of this example is stable matter to heat.

[0034] \*\* the powder of the fluorescence-spectrum profit \*\*\*\* matter was used as the 0.1mmol ethanol solution, and the fluorescence spectrum of the solution of this matter was measured As shown in drawing 2 , the blue fluorescence spectrum which has a peak in 417.2nm was observed. This maximum excitation spectrum was 381nm.

[0035] \*\* the vacuum evaporatio of the powder of the fluorescence-spectrum profit \*\*\*\* matter of a thin film was carried out to the glass substrate, and the fluorescence spectrum in a thin film was measured As shown in drawing 3 , the peak was a with a half-value width [ of 100nm ] blue fluorescence spectrum in 468nm. The maximum excitation wavelength of this spectrum was 467nm.

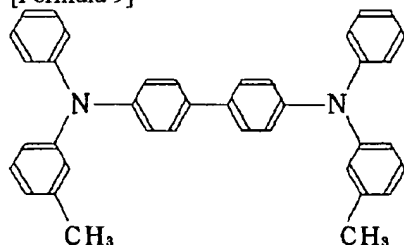
[0036] \*\* The ionization potential of the powder of the matter obtained potentially [ ionization ] was measured by the cyclic voltammetry. Consequently, although the clear peak has not been observed, it was a value which is 4.96 (eV) grades.

[0037] \*\* the vacuum evaporatio of the powder of the band-gap profit \*\*\*\* matter was carried out to the glass substrate, and it asked for the band gap from the absorption Eg: It was 3.13(eV).

[0038] 3) As manufacture \*\*\*\* of an EL element, and an example of comparison, make organic EL-element material of this example into an organic luminous layer, and create the organic EL element of the two-layer structure which combined the hole-injection transporting bed with this. First, after setting a glass substrate with ITO in a vacuum evaporation system and making it into the vacuum of 10-5torr after washing and dryness, 30nm vacuum evaporatio of the TPD as a hole-injection transporting bed is carried out, and next, it is aluminum 2O(OXZ) 4 of this example. 50nm was deposited. \*\* 9 shows the structure expression of TPD.

[0039]

[Formula 9]



[0040] The vacuum was once canceled, the vacuum evaporatio of the magnesium was further carried out as an up electrode, and the EL element was completed.

[0041] When the direct current voltage of minus was applied to the ITO side of this element at the plus and magnesium side, it is a maximum of 5 cd/m<sup>2</sup>. Blue luminescence was shown.

[0042] Although an electron hole goes into an organic luminous layer, since the work function of Mg which is a cathode is large according to this example, it is thought that an electron cannot enter easily. For this reason, it is hard to shine and brightness stops at the numeric value of the grade mentioned above.

[0043] Then, in order to put an electron into an organic luminous layer, in the organic EL element which used an organic EL-element material of this example for the organic luminous layer, we decided to adopt the structure which sandwiched the organic luminous layer by the hole-injection transporting bed and the electron-injection transporting bed. As shown in drawing 1 , the glass substrate 1 on which ITO which is an anode 2 was put is washed. After setting in a vacuum evaporation system and making it the vacuum of 10-5torr after dryness, TPD3 as a hole-injection transporting bed -- 30nm vacuum evaporatio -- carrying out -- once -- a vacuum -- canceling -- a degree -- aluminum 2O(OXZ) 4 from -- 35nm vacuum evaporatio of the becoming organic luminous layer 4 was carried out, and Alq<sub>3</sub> 5 [ 25nm ] as an electron-injection transporting bed were deposited further The vacuum evaporatio of the Mg:Ag alloy (or aluminum:Li alloy) was carried out as a cathode 6 which is furthermore an up electrode, and the EL element was completed. In addition, you may prepare m-MTDATA and a copper phthalocyanine as a buffer layer between an anode 2 and TPD3.

[0044] When the direct current voltage of minus was applied to the anode 2 side (ITO side) of this organic EL element at the plus and cathode 6 side (magnesium side), it is a maximum of 1314 cd/m<sup>2</sup> at 16V. Blue EL luminescence was shown. The emission spectrum is shown in drawing 4 . Peak wavelength was 420nm, chromaticity coordinates are x= 0.185 and y= 0.178 on a C.I.E. chromaticity diagram, and high blue luminescence of purity was obtained.

[0045] Even if it uses an organic EL-element material of this example, by the EL element of two-layer structure, i.e., the structure of ITO/TPD/aluminum<sub>2</sub> O(OXZ)4 /Mg, effective luminescence is not almost obtained, so that I may be understood from the example of the organic EL element of the two-layer structure which is an example of comparison, and the organic EL element of the three-tiered structure of an example 1. The LUMO level of an organic luminous layer is 1.82 (eV), and since the work function of Mg is 3.7 (ev) and an electron is the obstruction of 1.9 (eV) exists and ] hard to be poured in from a cathode, this is considered that luminescence brightness was low.

[0046] Then, as it mentions above and was shown in drawing 1 , this energy barrier was able to be made low by preparing Alq<sub>3</sub> 5 as an electron-injection transporting bed between a cathode 6 and the organic luminous layer 4. Alq<sub>3</sub> Since it is 2.35 (eV), LUMO level is a cathode and Alq<sub>3</sub>. Between is set to 1.35 (eV) and it is Alq<sub>3</sub>. aluminum 2O(OXZ) 4 Since between is set to 0.53 (eV), an electron becomes is easy to be poured in to the organic luminous layer 4, and luminescence brightness improves. Therefore, the organic EL element which used an organic EL-element material of this example for the organic luminous layer needs to consider as the structure which sandwiched the organic luminous layer at a hole-injection transporting bed and an electron-injection transporting bed.

[0047] As the aforementioned hole-injection transporting bed, the class [ third ] others, for example, aromatic series, amine [ TPD ], a hydrazone derivative, a carbazole derivative, a triazole derivative, an imidazole derivative, and the OKISA diazole derivative that has an amino group can be used.

[0048] When dividing and installing the aforementioned hole-injection transporting bed in a hole-injection layer and an electron hole transporting bed, a desirable combination can be chosen and used out of the compound for hole-injection transporting beds. At this time, it is desirable to carry out a laminating to the order of the layer of the small compound of ionization potential from anode plate sides (ITO etc.).

[0049] Specifically, triphenylamine derivatives (m-MTDATA etc.), a copper phthalocyanine, etc. which are called starburst amine are used for a hole-injection layer. TPD which is the dimer of a triphenylamine can be used for electron hole transportation material.

[0050] as an electron-injection transporting bed -- the above Alq3 others -- organometallic complex derivatives, such as an aluminum quinolinol, an OKISA diazole derivative, a pyridine derivative, a pyrimidine derivative, a quinoline derivative, a quinoxaline derivative, a diphenyl quinone derivative, a perylene derivative, and a nitration fluorene derivative can be used

[0051] When dividing and installing an electron-injection transporting bed in an electron-injection layer and an electronic transporting bed, a desirable combination can be chosen and used out of the compound for electron-injection transporting beds. It is desirable to carry out a laminating to the order of the layer of a compound with the large value of an electron affinity from a cathode side at this time.

[0052] Although the charge of organic EL-element material of this example shown in \*\* 8 is blue luminescence, wavelength conversion is possible by making this charge of organic EL-element material into host material, and doping other fluorescence nature matter to this. For example, organic coloring matters, such as a Quinacridone (yellowish green), rubrene (yellow), a coumarin (bluish green), and styryl coloring matter (long wave blue by the side of merit), and rare earth complexes, such as an europium complex, can be used as other fluorescence nature matter. The fluorescence nature matter is usable one or more kinds, and, as for the content, less than [ of \*\* 8 / 5 mol % ] is desirable. An emission spectrum can be shifted to a long wavelength side by using such a compound. If each color which was mentioned above can be taken out, since the color of almost all visible regions can be covered, multicolor or a full color organic EL element is realizable.

[0053] Moreover, the aforementioned organic luminous layer can be made to contain a singlet-oxygen quencher. As such a quencher, a nickel complex, rubrene, a diphenyl iso benzofuran, the third class amine, etc. can be used. As for the content of a quencher, less than [ of \*\* 8 / 10 mol % ] is desirable.

[0054] Especially although the thickness of the aforementioned organic luminous layer, the thickness of the aforementioned hole-injection transporting bed, and especially the thickness of the aforementioned electron-injection transporting bed are not limited but change also with formation methods, it is usually desirable to be referred to as 8-200nm about 5-1000nm.

[0055] It is desirable to use the alloy which contains a small material of a work function, for example, Li, Na, Mg, aluminum, Ag, and In(s), and these one or more sorts in the aforementioned cathode 6.

[0056] In order to carry out field luminescence of the aforementioned organic EL element, one [ at least ] electrode needs to be transparence or translucence. It is good to specifically constitute from conductive polymer, such as ITO, SnO2, nickel, Au, Pt and Pd, and polypyrrole, etc., and to set resistance as the range of 10-30ohms / \*\*.

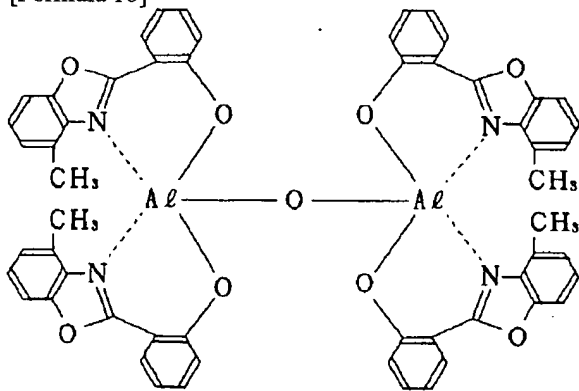
[0057] In order to take out luminescence through this substrate 1, the transparence or a translucent material of glass, a resin, etc. is used for the aforementioned substrate 1. Moreover, a color filter film and a conductor reflective film may be used on a substrate 1, and the luminescent color may be controlled.

[0058] As for the aforementioned cathode 6 and the aforementioned anode 2, in the manufacture method of an organic EL element mentioned above, forming by the vacuum deposition, the spatter, etc. is desirable. As for the aforementioned hole-injection transporting bed, the aforementioned organic luminous layer, and the aforementioned electron-injection transporting bed, forming by the vacuum deposition method is desirable.

[0059] (2) aluminum 2O(OXZ) 4 which is an organic electroluminescent-element material of example 2 example 2 A structure expression is shown in \*\* 10.

[0060]

[Formula 10]



[0061] 1) the beaker of 500ml of synthetic methods -- toluene 200ml -- putting in -- further -- 2-(2-hydroxyphenyl)- add 4-methyl benzo oxazole 4.5g (0.02 mols) and aluminum-G normal butoxy-monoethyl acetate 3.2g (0.01 mols), and carry out the stirring dissolution at a room temperature This solution is left one whole day and night. Next, vacuum distillation is carried out and toluene is removed. The solid content which remained is washed with toluene. It dried in the vacuum after that. \*\*\*\* of this rough product was 48%. Furthermore, after performing recrystallization and sublimation refining and removing an impurity, it uses as an organic EL material.

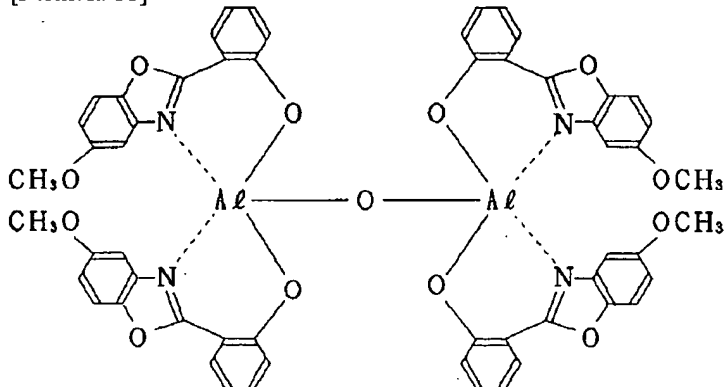
[0062] 2) Mass analysis, elemental analysis, FT-IR, NMR, and thermal analysis determined the structure of the identification product of a product.

Mass analysis: m/e 966 (M<sup>+</sup>)

Elemental analysis: C<sub>56</sub>H<sub>40</sub>N<sub>4</sub>O<sub>9</sub> aluminum<sub>2</sub> C H N Calculated value / % 69.57 4.14 5.80 Measured value / % 69.30 4.06 5.65 [0063] (3 aluminum 2O(OXZ))<sub>4</sub> which is an organic electroluminescent-element material of example 3 example 3 A structure expression is shown in \*\* 11.

[0064]

[Formula 11]



[0065] 1) Put toluene 200ml into the beaker of 500ml of synthetic methods, further, add 2-(2-hydroxyphenyl)-5-methoxybenzoxazole 4.82g (0.02 mols) and aluminum-G normal butoxy-monoethyl acetate 3.2g (0.01 mols), and carry out the stirring dissolution at a room temperature. This solution is left one whole day and night. Next, vacuum distillation is carried out and toluene is removed. The solid content which remained is washed with toluene. It dried in the vacuum after that. \*\*\*\* of this rough product was 45%. Furthermore, after performing recrystallization and sublimation refining and removing an impurity, it uses as an organic EL material.

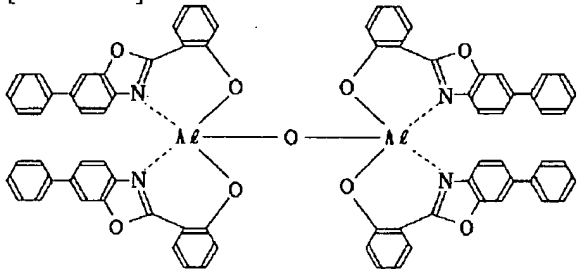
[0066] 1) Mass analysis, elemental analysis, FT-IR, NMR, and thermal analysis determined the structure of the identification product of a product.

Mass analysis: m/e 1030 (M<sup>+</sup>)

Elemental analysis: C<sub>56</sub>H<sub>40</sub>N<sub>4</sub>O<sub>13</sub>aluminum<sub>2</sub> C H N Calculated value / % 65.24 3.88 5.44 Measured value / % 65.12 3.72 5.23 [0067] (4 aluminum 2O(OXZ))<sub>4</sub> which is an organic electroluminescent-element material of example 4 example 4 A structure expression is shown in \*\* 12.

[0068]

[Formula 12]



[0069] 1) Put toluene 200ml into the beaker of 500ml of synthetic methods, further, add 2-(2-hydroxyphenyl)-6-phenylbenzo oxazole 5.74g (0.02 mols) and aluminum-G normal butoxy-monoethyl acetate 3.2g (0.01 mols), and carry out the stirring dissolution at a room temperature. This solution is left one whole day and night. Next, vacuum distillation is carried out and toluene is removed. The solid content which remained was washed with toluene and it dried in the vacuum after that. \*\*\*\* of this rough product was 52%. Furthermore, after performing recrystallization and sublimation refining and removing an impurity, it uses as an organic EL material.

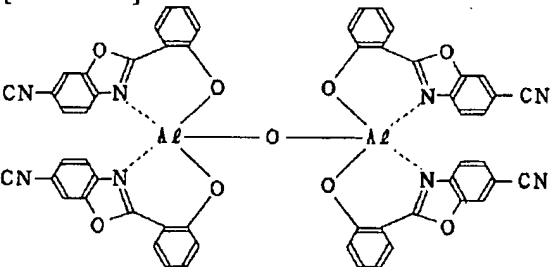
[0070] 2) Mass analysis, elemental analysis, FT-IR, NMR, and thermal analysis determined the structure of the identification product of a product.

Mass analysis: m/e 1214 (M<sup>+</sup>)

Elemental analysis: C<sub>76</sub>H<sub>48</sub>N<sub>4</sub>O<sub>9</sub> aluminum<sub>2</sub> C H N Calculated value / % 75.12 3.95 4.61 Measured value / % 75.22 3.83 4.53 [0071] (5 aluminum 2O(OXZ))<sub>4</sub> which is an organic electroluminescent-element material of example 5 example 5 A structure expression is shown in \*\* 13.

[0072]

[Formula 13]



[0073] 1) the beaker of 500ml of synthetic methods -- toluene 200ml -- putting in -- further -- 2-(2-hydroxyphenyl)- add 6-cyano benzo oxazole 4.22g (0.02 mols) and aluminum-G normal butoxy-monoethyl acetate 3.2g (0.01 mols), and carry out the stirring dissolution at a room temperature This solution is left one whole day and night. Next, vacuum distillation is carried out and toluene is removed. The solid content which remained is washed with toluene. It dried in the vacuum after that. \*\*\*\* of this rough product was 50%. Furthermore, after performing recrystallization and sublimation refining and removing an impurity, it uses as an organic EL material.

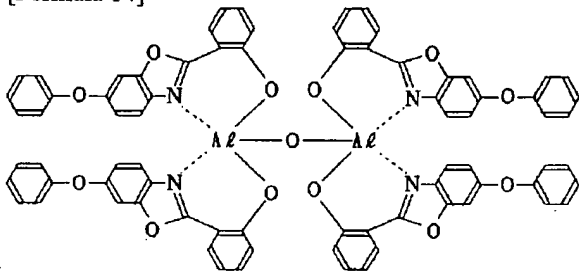
[0074] 2) Mass analysis, elemental analysis, FT-IR, NMR, and thermal analysis determined the structure of the identification product of a product.

Mass analysis: m/e 1010 (M+)

Elemental analysis: C<sub>56</sub>H<sub>28</sub>N<sub>8</sub>O<sub>9</sub> aluminum<sub>2</sub> C H N Calculated value / % 66.53 2.77 11.09 Measured value / % 66.61 2.62 11.14 [0075] (6) aluminum 2O(OXZ) 4 which is an organic electroluminescent-element material of example 6 example 6 A structure expression is shown in \*\* 14.

[0076]

[Formula 14]



[0077] 1) the beaker of 500ml of synthetic methods -- toluene 200ml -- putting in -- further -- 2-(2-hydroxyphenyl)- add 6-phenoxy benzo oxazole 6.06g (0.02 mols) and aluminum-G normal butoxy-monoethyl acetate 3.2g (0.01 mols), and carry out the stirring dissolution at a room temperature This solution is left one whole day and night. Next, vacuum distillation is carried out and toluene is removed. The solid content which remained is washed with toluene. It dried in the vacuum after that. \*\*\*\* of this rough product was 42%. Furthermore, after performing recrystallization and sublimation refining and removing an impurity, it uses as an organic EL material.

[0078] 2) Mass analysis, elemental analysis, FT-IR, NMR, and thermal analysis determined the structure of the identification product of a product.

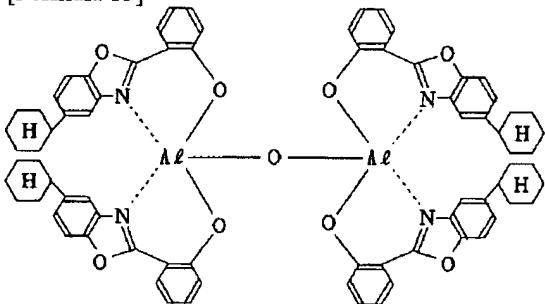
Mass analysis: m/e 1278 (M+)

Elemental analysis: C<sub>76</sub>H<sub>48</sub>N<sub>4</sub>O<sub>13</sub>aluminum<sub>2</sub> C H N Calculated value / % 71.36 3.76 4.38 Measured value / % 71.35 3.81 4.21 [0079]

(7) aluminum 2O(OXZ) 4 which is an organic electroluminescent-element material of example 7 example 7 A structure expression is shown in \*\* 15.

[0080]

[Formula 15]



[0081] 1) the beaker of 500ml of synthetic methods -- toluene 200ml -- putting in -- further -- 2-(2-hydroxyphenyl)- add 5-cyclohexyl benzo oxazole 5.86g (0.02 mols) and aluminum-G normal butoxy-monoethyl acetate 3.2g (0.01 mols), and carry out the stirring dissolution at a room temperature This solution is left one whole day and night. Next, vacuum distillation is carried out and toluene is removed. The solid content which remained is washed with toluene. It dried in the vacuum after that. \*\*\*\* of this rough product was 49%. Furthermore, after performing recrystallization and sublimation refining and removing an impurity, it uses as an organic EL material.

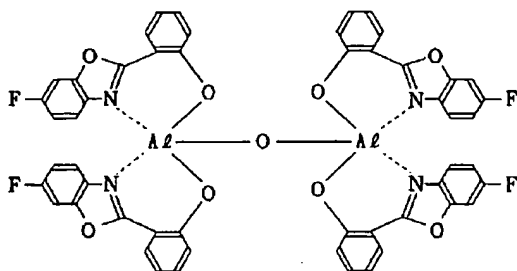
[0082] 2) Mass analysis, elemental analysis, FT-IR, NMR, and thermal analysis determined the structure of the identification product of a product.

Mass analysis: m/e 1238 (M+)

Elemental analysis: C<sub>76</sub>H<sub>72</sub>N<sub>4</sub>O<sub>9</sub> aluminum<sub>2</sub> C H N Calculated value / % 73.67 5.82 4.52 Measured value / % 73.55 5.71 4.59 [0083] (8) aluminum 2O(OXZ) 4 which is an organic electroluminescent-element material of example 8 example 8 A structure expression is shown in \*\* 16.

[0084]

[Formula 16]



[0085] 1) Put toluene 200ml into the beaker of 500ml of synthetic methods, further, add 2-(2-hydroxyphenyl)-6-fluorobenzo oxazole 4.58g (0.02 mols) and aluminum-G normal butoxy-monoethyl acetate 3.2g (0.01 mols), and carry out the stirring dissolution at a room temperature. This solution is left one whole day and night. Next, vacuum distillation is carried out and toluene is removed. The solid content which remained is washed with toluene. It dried in the vacuum after that. \*\*\*\* of this rough product was 55%. Furthermore, after performing recrystallization and sublimation refining and removing an impurity, it uses as an organic EL material.

[0086] 2) Mass analysis, elemental analysis, FT-IR, NMR, and thermal analysis determined the structure of the identification product of a product.

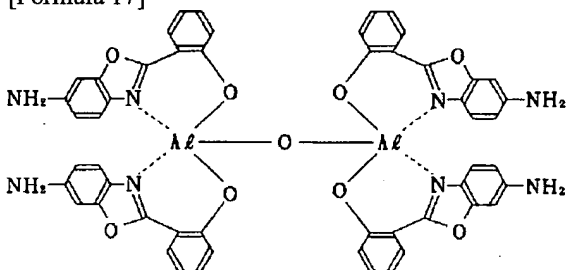
Mass analysis: m/e 982 (M+)

Elemental analysis: C<sub>52</sub>H<sub>28</sub>N<sub>4</sub>O<sub>9</sub> aluminum two F<sub>4</sub> C H N Calculated value / % 63.54 2.85 5.70 Measured value / % 63.50 2.76 5.65

[0087] (9) aluminum 2O(OXZ) 4 which is an organic electroluminescent-element material of example 9 example 9 A structure expression is shown in \*\* 17.

[0088]

[Formula 17]



[0089] 1) Put toluene 200ml into the beaker which is 500ml of synthetic methods, further, add 2-(2-hydroxyphenyl)-6-AMINO BENZO oxazole 4.33g (0.02 mols) and aluminum-G normal butoxy-monoethyl acetate 3.2g (0.01 mols), and carry out the stirring dissolution at a room temperature. This solution is left one whole day and night. Next, vacuum distillation is carried out and toluene is removed. The solid content which remained is washed with toluene. It dried in the vacuum after that. \*\*\*\* of this rough product was 51%. Furthermore, after performing recrystallization and sublimation refining and removing an impurity, it uses as an organic EL material.

[0090] 2) Mass analysis, elemental analysis, FT-IR, NMR, and thermal analysis determined the structure of the identification product of a product.

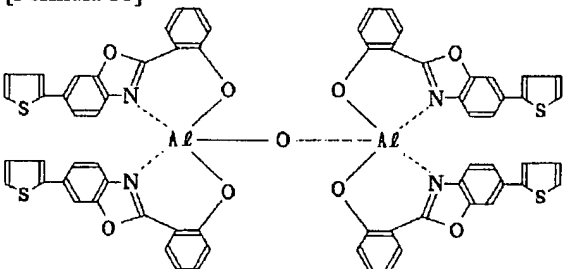
Mass analysis: m/e 970 (M+)

Elemental analysis: C<sub>52</sub>H<sub>36</sub>N<sub>8</sub>O<sub>9</sub> aluminum2 C H N Calculated value / % 64.33 3.71 11.55 Measured value / % 64.21 3.63 11.45 [0091]

(10) aluminum 2O(OXZ) 4 which is an organic electroluminescent-element material of example 10 example 10 A structure expression is shown in \*\* 18.

[0092]

[Formula 18]



[0093] 1) the beaker of 500ml of synthetic methods -- toluene 200ml -- putting in -- further -- 2-(2-hydroxyphenyl)- add 6-(2-thienyl) benzo oxazole 5.87g (0.02 mols) and aluminum-G normal butoxy-monoethyl acetate 3.2g (0.01 mols), and carry out the stirring dissolution at a room temperature This solution is left one whole day and night. Next, vacuum distillation is carried out and toluene is removed. The solid content which remained is washed with toluene. It dried in the vacuum after that. \*\*\*\* of this rough product was 56%. Furthermore, after performing recrystallization and sublimation refining and removing an impurity, it uses as an organic EL material.

[0094] 2) Mass analysis, elemental analysis, FT-IR, NMR, and thermal analysis determined the structure of the identification product of a product.

Mass analysis: m/e 1238 (M+)

Elemental analysis: C<sub>68</sub>H<sub>40</sub>N<sub>4</sub>O<sub>9</sub> S<sub>4</sub> aluminum2 C H N Calculated value / % 65.91 3.23 4.52 Measured value / % 65.76 3.11 4.41 [0095]

the publication of each item to which, as for these matters in examples 2-10, an example 1 is equivalent although the effect at the time of

using it for the organic luminous layer of the thermal analysis of the compound product, a fluorescence spectrum, ionization potential, a band gap, and an organic EL element in the examples 2-10 explained above was not explained, and abbreviation -- it became the same content. That is, for each matter of examples 2-10, the melting point is Alq3. It is high, a blue fluorescence spectrum with high purity is shown, and ionization potential is Alq3. It excelled and the band gap was of the same grade as the example 1. Furthermore, the organic EL element of the aforementioned three-tiered structure manufactured using these matter showed high blue luminescence of luminescence brightness of the same grade as an example 1, and purity.

[0096]

[Effect of the Invention] To heat, an organic EL-element material of this invention is stable, and cannot deteriorate easily, and high blue luminescence of purity is obtained. And since according to the organic EL element using this organic EL-element material the element structure was a three-tiered structure which sandwiched the organic luminous layer by the electron-injection transporting bed and the hole-injection transporting bed while preservation stability could perform good high blue luminescence of purity rather than the conventional organic EL element, the diffusion to the electrode of an exciton was prevented, efficiency improved, the reactive current decreased, and the life has been improved.

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[Translation done.]